Mineral Fiber Exposure Assessments: What should we measure? What can we measure? Analytical Options

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Conceptual Model

for development of methods for prospective assessment of health risks associated with exposures to mineral fibers

epidemiology

Effects

dose-response

rel. potencies

Dose in tissues

respiration

retention/clearance

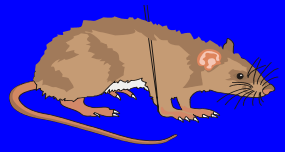
translocation

Exposures

fate/transport

Sources

toxicology



Key question: what dose in tissues/lung should not be exceeded?

Temporal exposure issues - lifetime, short term, early life stages

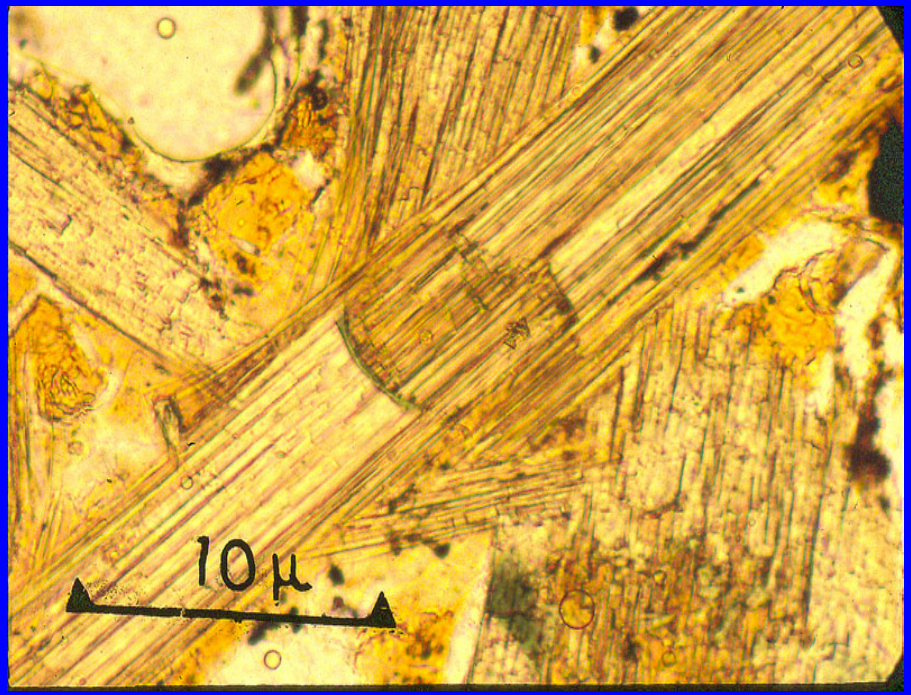
There are many different fiber risk assessment problems. It is therefore logical that requirements for analytical methods will vary and that risk assessors need a suite of methods to choose from and/or use in combination.

Uncertainties for what to measure are an impediment for development of optimum analytical methods for assessing risks from exposures to all durable fibers which may be inhaled.

A Major Complication for Risk Assessors: Mineral Fibers Have Diverse Origins and Properties When Removed from Rocks

Chrysotile asbestos cross-fiber vein

Amphibole crystals in taconite (iron ore) - ferroactinolite replacing hornblende



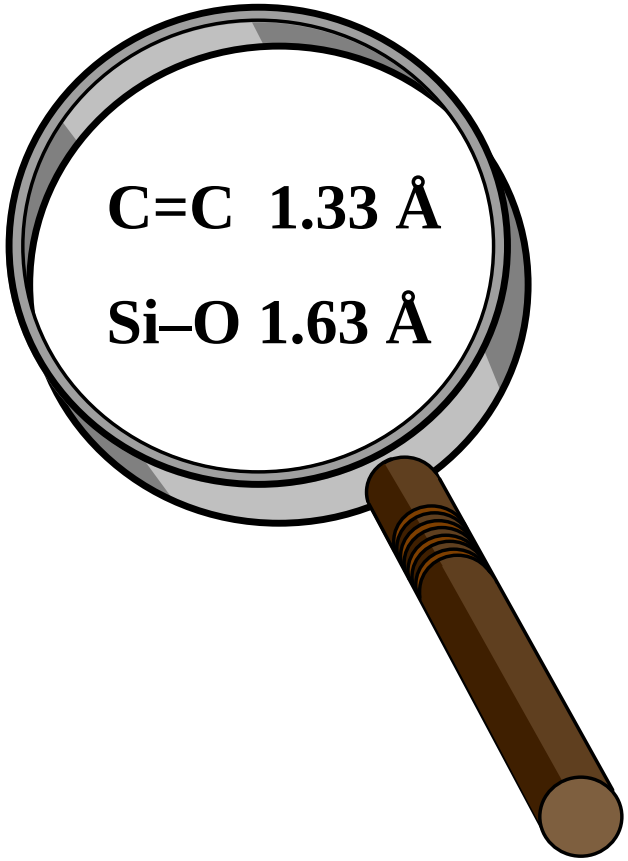
Phagocytosis of asbestos fibers

pulmonary alveolar macrophage cell attempting to engulf and ingest several long crocidolite asbestos fibers

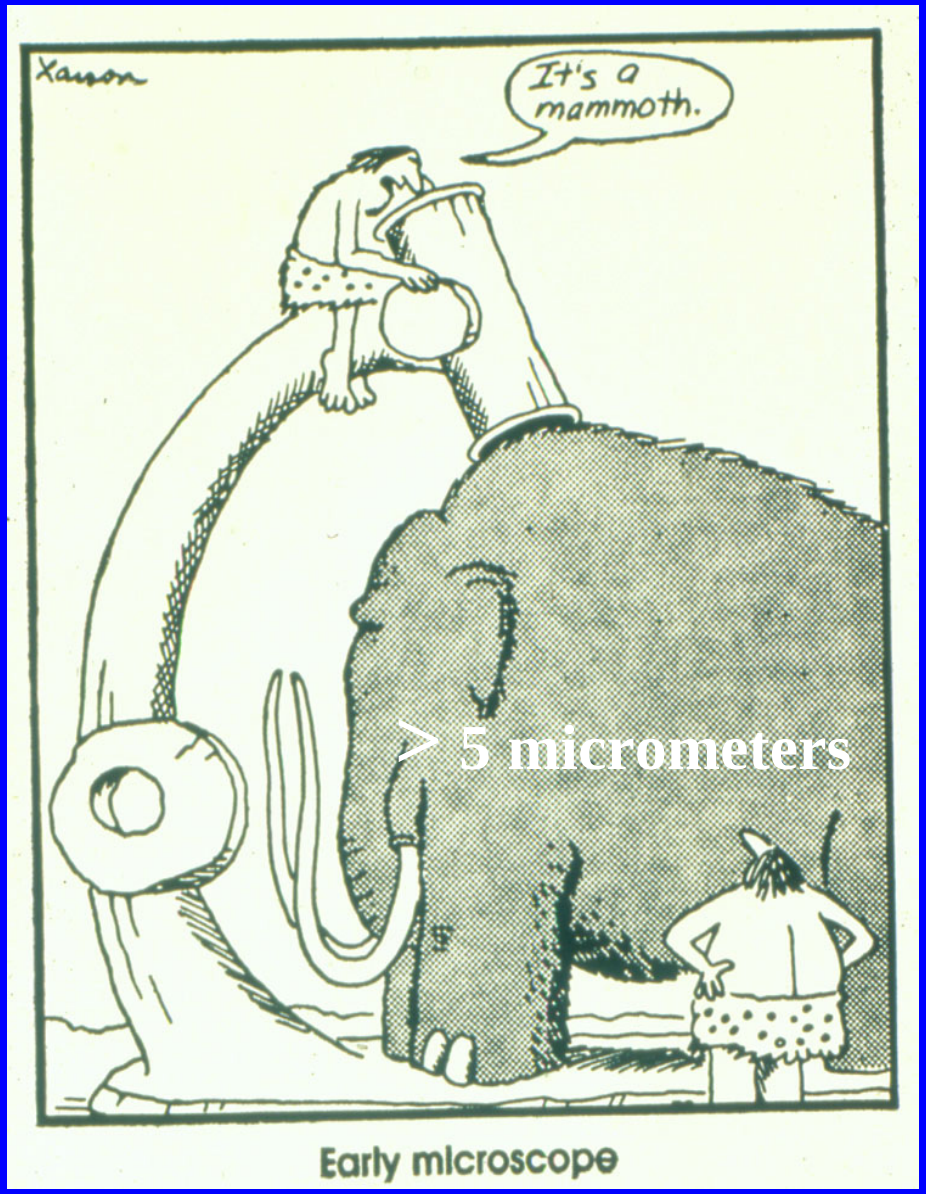
incomplete ingestion of asbestos fibers can lead to extensive ‘selective release’ of proteolytic enzymes and ROS from the ‘frustrated’ PAMs

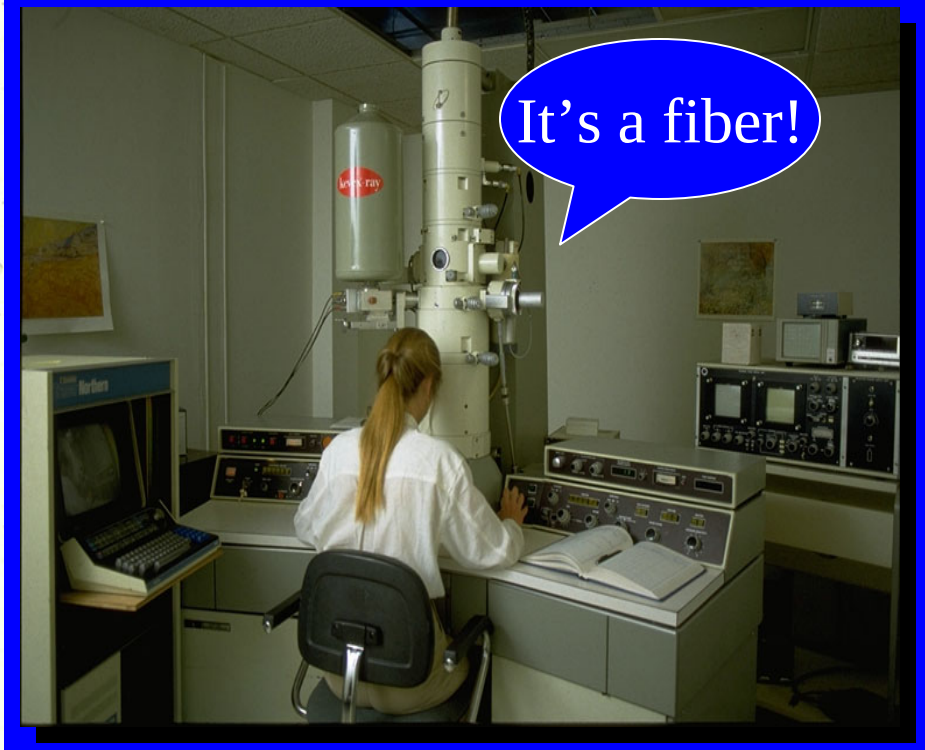
Measures of Small Sizes

- **millimeter (mm) 10^{-3} m**
- **micrometer (λm) 10^{-6} m**
- **nanometer (nm) 10^{-9} m**
- **angstrom (Å) 10^{-10} m**



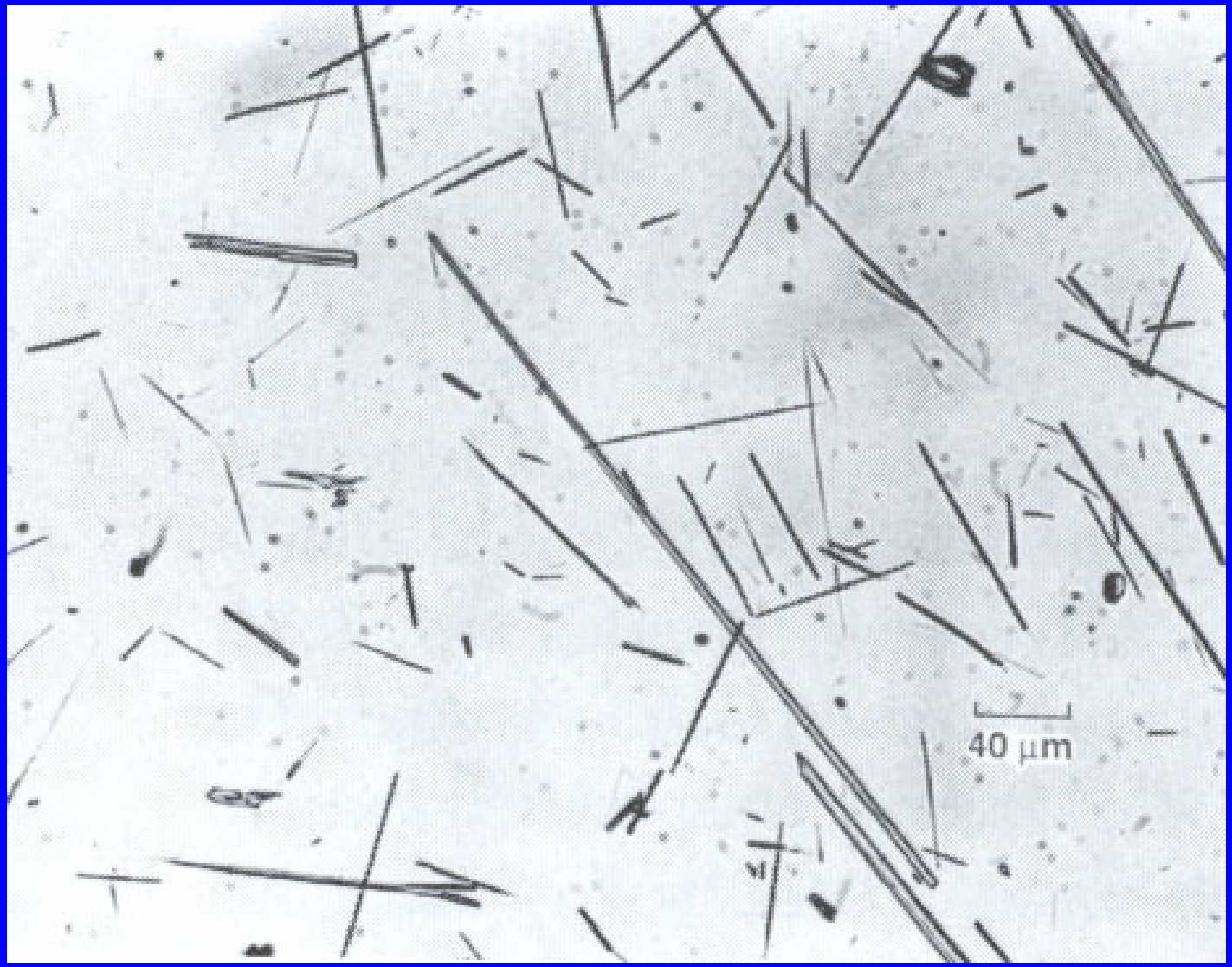
Tempus fugit





Transmission Electron Microscope (TEM)

Tremolite acicular “Cleavage Fragments” ?



Amphibole asbestos fibers have complex crystalline structures that may regulate size and shape changes in response to physical, chemical and biological processes.

Cleavage of asbestiform fibers can occur and the resulting fibers (cleavage fragments?) are unlikely to be less toxic than the original fibers.

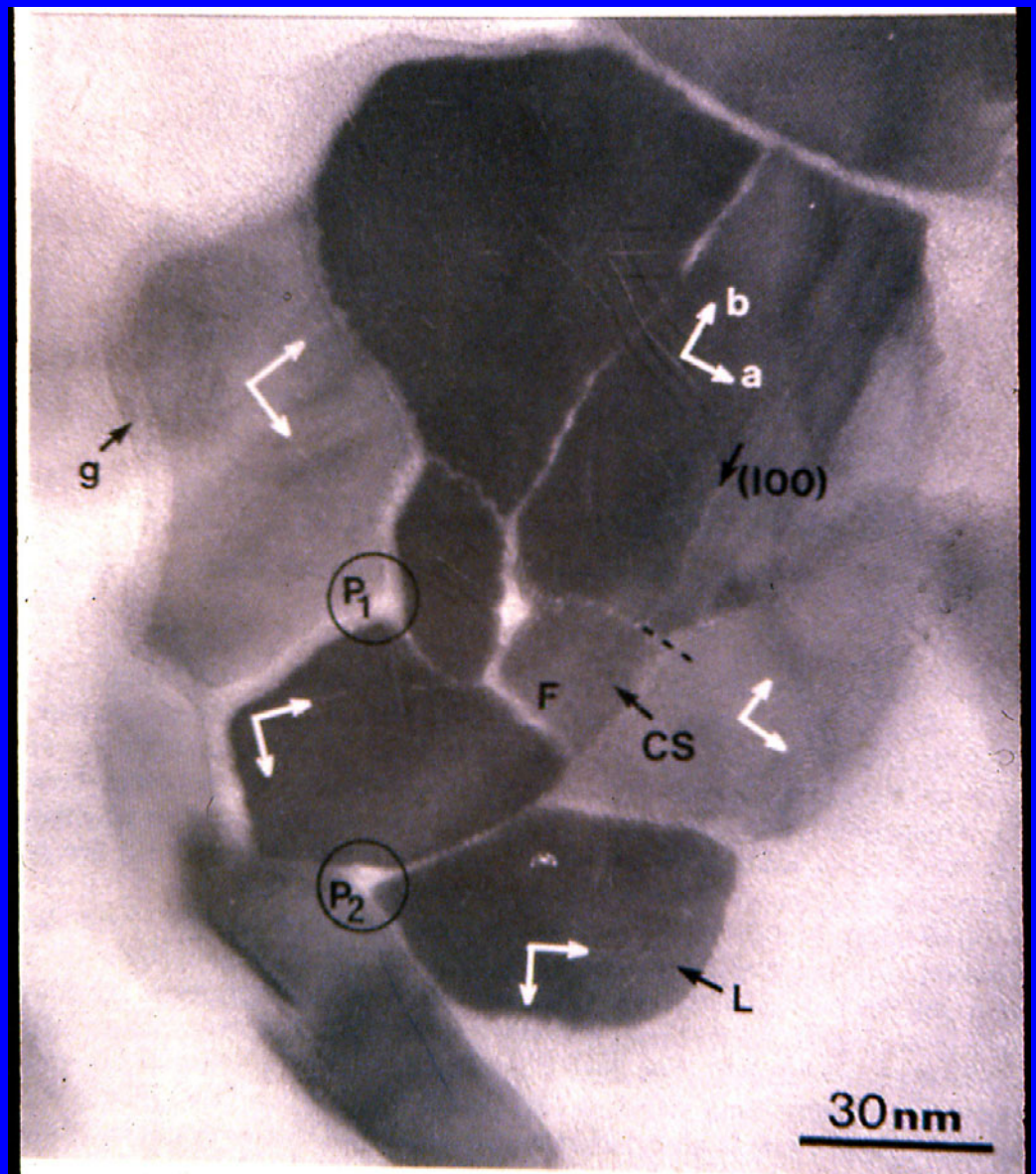


Fig. 2. Lattice image of a transverse section of a crocidolite fibre taken from human blood serum. This image was recorded with *hk*0 beams contributing to the image. See text for details.

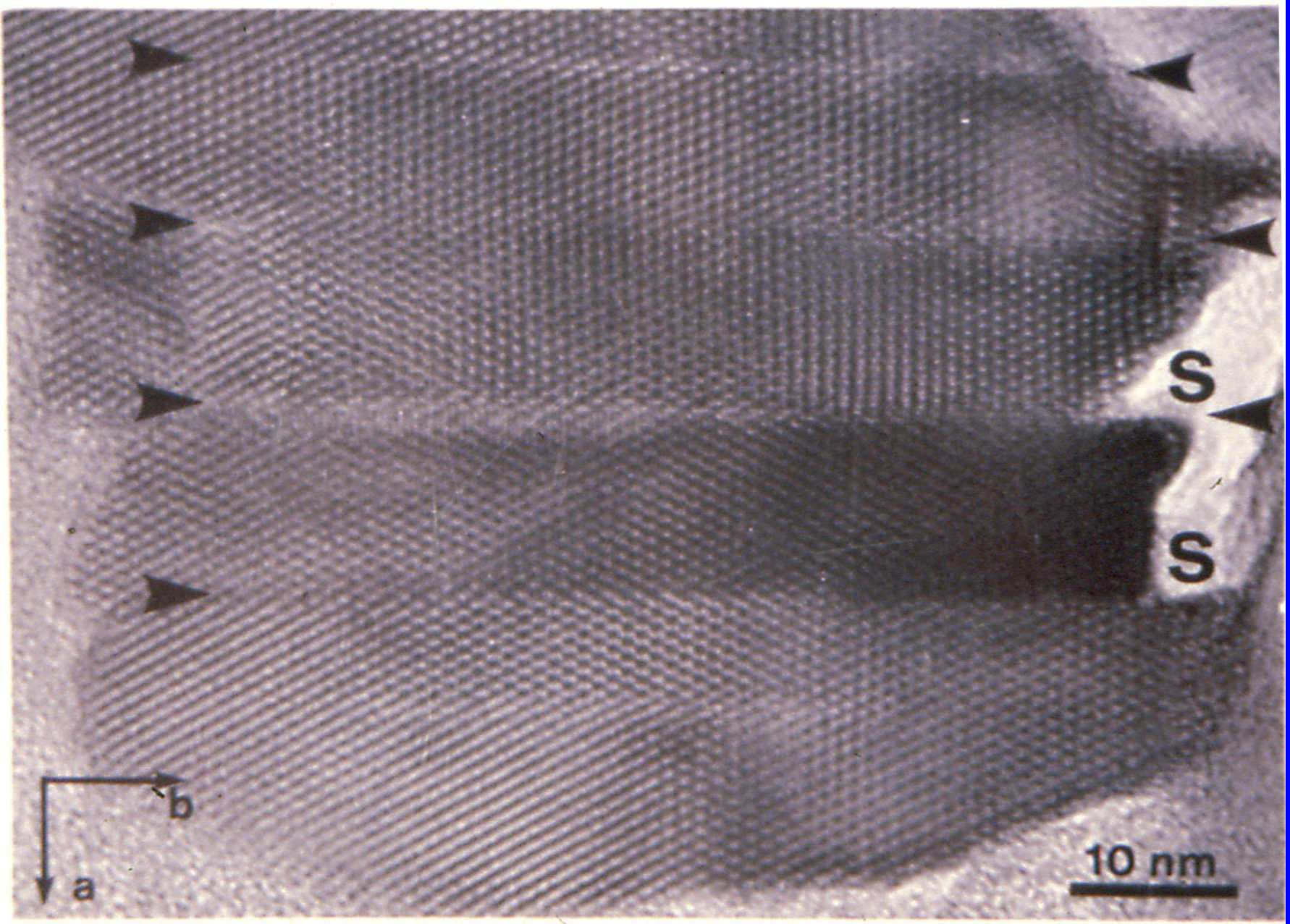


Fig. 3. Lattice image of a transverse section of crocidolite. (100) defects are arrowed. Note the surface steps at S.